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Compiled By
CHARLES E. SHAW

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A Southern-most Coast Range Locality For CHARINA BOTTAE

By W. Leslie Burger

Contribution from the University of Illinois Museum of Natural History.

An adult female Pacific rubber snake (University of Illinois Museum of Natural History number 4926) from the San Francisco State College Camp in Bixby Canyon, approximately 20 miles southeast of Monterey, California, is of very special interest for a number of reasons. The locality is on the humid Pacific slope in the northern portion of the 180 mile gap between the previously known ranges of the northern coastal subspecies, *Charina bottae bottae* (Blainville), and the southern interior subspecies, *C. b. umbratica* Klauber. While, as will be discussed presently, the weight of evidence places it with the northern form, the specimen approaches *umbratica* in at least one important respect: number of rows of dorsal scales. If I did not remember the precise details of collecting it, (it was stretched out in the sun on the bank of a creek) and were it not the only specimen of the species in the summer's collection, I would suspect an error in my records since the number of dorsal scales is decidedly atypical for the northern race reported from not far distant Carmel (Klauber, 1943:84).

The present specimen has a maximum of 43 rows of dorsal scales at midbody and 196 ventrals. According to the most recent analysis of the subspecies (Klauber, *op. cit.*) the first character would place it in either *umbratica* (dorsals, 39 to 41 in two specimens) or the Great Basin subspecies, *C. b. utahensis* Van Denburg (dorsals, 44 or less) and exclude it from *bottae* (dorsals, 45 or more); the second character would place it in either *bottae* (ventrals, 192 to 220) or *utahensis* (ventrals, 192 to 214) and exclude it from *umbratica* (ventrals, 184 to 190 in two specimens). In the taxonomic key presented by Klauber the sequence of characters would cause it (and, as dicussed below, the holotype of *bottae*) to be identified as the Great Basin subspecies, known in northeastern California and approaching via the Sierra Nevada no closer than 175 miles.

In head scales the Bixby Canyon specimen is typical of *bottae*: the frontal is angular posteriorly; the supraoculars deeply indent with a sharp point the suture between the frontal and parietal; and the parietal is crescentic and divided medially. In all three respects it differs from the two type specimens of *umbratica*, and the division of the parietals indicates distinction from typical *utahensis*.

The low number of dorsal scale rows in this Coast Range specimen is of considerable nomenclatorial importance. The type locality of *bottae* was stated merely as "Californie" (Blainville, 1835). The divided parietal, curved frontal-parietal suture, and high number (202) of ventrals in the holotype all point to coastal California, where Botta is known to have collected, as its source. According to Klauber (1943:87-88), however, the low number, 43, of dorsal scale rows "would be questionable for a specimen from coastal California." The present specimen, with the same number of dorsals, by confirming the possibility effectively dismisses the question.

Association of these two specimens the holotype of *bottae* and the present specimen, both with 43 dorsals-with the subspecies presently recognized as *bottae* remains a matter of conjecture. The reported consistency of occurrence of more than 43 scale rows in *bottae* (*auct.*) except where it intergrades with *utahensis* suggests that rather than chance individual variants the two specimens represent either (1) a population intergrading with *umbratica* or (2) a distinct, perhaps annectant, subspecies present in the southern end of the Coast Range. Additional specimens will be necessary to clarify the situation.

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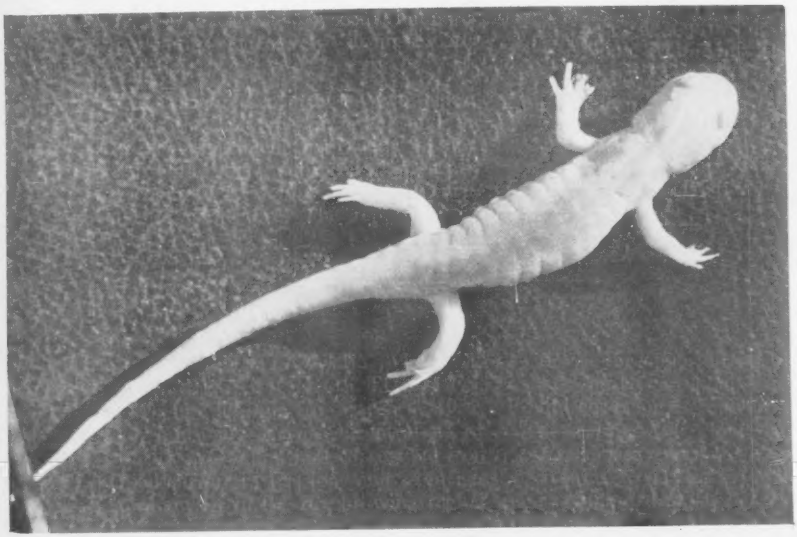
AN UNUSUALLY LARGE CONGREGATION OF TURTLES. —On the morning of March 4, 1951, an unusually large concentration of turtles was found in a corrugated iron road culvert 12 feet long and 24 inches in diameter in the rice growing region about two and a half miles northeast of Long Point, Brazoria County, Texas. At one end of the culvert was a borrow pit about 20 x 10 x 5 feet containing a pool of water. These pools usually afford excellent habitats for aquatic life, but a long drought had left them practically dry.

An exhaustive search of the pool produced only two small *Pseudemys scripta elegans*. No turtles were discovered in a preliminary examination of the culvert with a 4 foot collecting rake, but further exploration with a long pole immediately produced turtles at the opposite end of the culvert. For nearly an hour turtles were removed from the culvert two or three at a time. The total count was 81 *Pseudemys scripta elegans* ranging from 2 to 11 inches in length and 2 juvenile *Chelydra s. serpentina*. All seemed to be normally active and attempted to escape when given the opportunity. The air temperature at the time (10:30 to 11:30 a.m.) was 60 degrees F. and the water temperature in both pools was 61 degrees F.

Diligent collecting in several miles of open ditches in the vicinity of the culvert produced 2 large *Natrix r. rhombifera* and one small *Natrix sipedon confluens* but no turtles.—Bryce C. Brown and Jesse Haver, Strecker Museum, Baylor University, Waco, Texas and 113 Christenson St., Houston, Texas.

ALBINO *AMBYSTOMA MACULATUM*.—The finding of albino amphibians has always excited much interest among herpetologists. It, therefore, has seemed worthwhile to record the capture of a completely albino salamander, *Ambystoma maculatum* (Shaw), in Washington County, Tennessee. The specimen was taken on the night of March 15 while collecting amphibians in a small pond formed in an abandoned railroad cut on the campus of the East Tennessee State Teachers College at Johnson City, Tennessee. The writer was accompanied by Mr. Pierce Carson of the State Teachers Colleg. The water in the pond stood fairly uniformly at a depth of about ten inches. The writer was busily engaged in a search for the *Pseudacris* which were calling near the edges of the pond, when Mr. Carson saw what appeared to be a small white "frog" lying on the bottom of the pond perhaps six feet from the bank. The "frog" actually was a beautiful, perfect albino, spotted salamander. It was captured immediately and eventually was placed in a vivarium. The salamander prospered on a diet of earthworms, two or three per week, until early in July. He was then preserved and is now in the writer's personal collection.

On the same night, twelve clumps of eggs of *Ambystoma maculatum* were observed in this pond. They were in various early stages of development. Six of these clumps, in an advanced state of development, were taken in to the laboratory. Each clump was placed in a separate dish and allowed to develop further. However, none of the tadpoles which escaped from the eggs appeared to show the albino character.



The albino salamander is a mature male. In form and measurements it conforms closely with the typically pigmented mature males. Length, 105 mm.; tail, 79 mm.; front toes, 1-4-2-3 in order of length; hind toes, 1-5-2-3-4 in order of length; color in life, a waxy, slightly translucent and faintly pinkish white. No indication whatever of spots.—B. B. Brandt, University of North Carolina, Raleigh, North Carolina.

Notes on Feeding Habits of Pacific Coast Garter Snakes*

By Wade Fox

The races of the *Thamnophis elegans* rassenkreis can be grouped into two ecological units: one consisting of those races that are known to feed exclusively on aquatic or amphibious food, and the other of those that feed mainly on terrestrial and only occasionally on amphibious food (Fox, 1951). Since it was felt that information pertaining to these differences in feeding habits might be valuable to persons attempting to keep members of this species in captivity, it seemed worthwhile to compile certain data relative to the feeding habits of the species. Although, in no sense, was there a series of rigidly controlled experiments, field observations and laboratory rearing of several hundred snakes over a period of four years have suggested the existence of certain definite feeding reactions and preferences that reveal the need for more exact investigations in this field.

Those races that have become highly specialized for aquatic feeding (*T. e. aquaticus, hydrophila, couchi, hammondi, gigas,* and *biscutatus*) have been found to prefer fish or frogs either in the wild or in captivity. A less highly specialized member of the aquatic group, *T. e. atratus,* eats salamanders as freely as fish or frogs. The races that are regarded as being primarily terrestrial in habits (*T. e. elegans, terrestris, vagrans, nigrescens,* and *hueyi*) are actually more generalized in their feeding than those of the other group. Both in the wild and in captivity *elegans* and *vagrans* were found to feed on fish, frogs, salamanders, slugs, rodents, and lizards. Presumably, *hueyi* and *nigrescens* are similar in feeding habits to *elegans* and *vagrans* respectively since the former subspecies are only slightly differentiated from the latter. Within the species *Thamnophis elegans,* the race *terrestris* is most specialized for a terrestrial habitat. Fitch (1940:96), discussing *terrestris* under the name of *T. ordinoides atratus,* states that 66 per cent of the specimens of this subspecies that he captured in the wild had fed on slugs. In the east bay region of the San Francisco Bay I have also found that the members of this subspecies feed largely on the giant slug, *Ariolimax columbianus**. On the San Francisco peninsula specimens of *terrestris* were found to be feeding almost exclusively on small rodents (mostly *Microtus californicus,* but also a few *Peromyscus maniculatus*). This seeming preference for rodents occurred despite the fact that there were frogs (*Rana aurora*), giant slugs (*Ariolimax californucus***), and salamanders (*Batrachoseps attenuatus* and *Taricha* (*Triturus*) *torosus*) available in quantity. In captivity specimens of *terrestris* from all localities fed readily upon rodents (newborn laboratory rats and mice), frogs (*Rana aurora* and *Hyla regilla*), salamanders (*Batrachoseps, Aneides,* and *Ensatina*), slugs (*Ariolimax columbianus* and the small grey garden slug, *Deroceras reticulatum**), and all types of fish offered to them. They refused the Pacific coast newts of the genus *Taricha* and the giant slug of the San Francisco peninsula, *Ariolimax californicus.* On one occasion I placed several of the latter slugs in an outdoor cage with a number of *terrestris* collected both on the peninsula and in the east bay region. Although the slugs from

*Observations reported in this paper were gathered incidental to other studies on *Thamnophis* at the University of California, Berkeley.

**I am grateful to Dr. Albert R. Mead for aid in the identification of slugs.

the peninsula lived in the cage for several months, they were never eaten by the snakes. Whether the discrimination between the two kinds of slugs which was shown by the snakes was due to the distinct color differences between those individuals of the two species which I had collected (for color variation in the genus *Ariolimax* see Mead, 1943), or to differences in odor to which the snakes were sensitive, I did not determine. In general, observation of the snakes inclines me to the belief that odor is the chief mechanism leading to the recognition of the slugs as food.

Odor appears to be the most important factor in recognition of all kinds of food among these garter snakes, although sight and certain conditioned responses may also play an important role. Evidence of the part that olfactory responses play in the recognition of slugs as food can be deduced from the behavior of *Thamnophis ordinoides*. Both wild and captive specimens of this species from Del Norte County, California, feed voraciously upon small gray slugs (*Deroceras reticulatum*). In captivity these snakes would not feed upon newborn laboratory mice until the latter were smeared with the secretions and body juices of the slugs. Response to the odor of the slugs was amazingly fast. A mere current of air blown over the slugs into the cage immediately alerted the snakes and usually stimulated them to quick searching movements. Odor from *Ariolimax columbianus* frequently produced the same behavior in *T. e. terrestris*. Captive individuals of the aquatic races did not respond to either the odor or presence of slugs.

Odor of *Hyla regilla* was found to produce violent feeding reactions in both terrestrial and aquatic snakes. After feeding on *Hyla* most snakes had to be starved for several weeks before they would accept less tempting food. *Rana aurora, Rana boyli,* and *Rana pipiens* were accepted freely by all races tested (*terrestris, elegans, vagrans, atratus, aquaticus, hydrophila, couchi,* and *hammondi*) but with less enthusiasm than *Hyla*. Although the young tadpoles of the bull frog, *Rana catesbeiana* were taken by all of the aquatic races tested, none of the snakes would feed on the nearly completely metamorphosed tadpoles, young frogs, or limbs of the adult bull frog. Not only was there a lack of response to the odor of the metamorphosed bull frog, but if the snakes were tricked into grasping a bull frog leg flipped erratically about the cage they would immediately release it. This aversion to adult *R. catesbeiana* is rather puzzling. It is possible that this species may have an odor that is distinct from the three above-mentioned *Rana* that are accepted as food. It may be that since *catesbeiana* is not native to the range of *Thamnophis elegans* but has been introduced relatively recently, it is not recognized as food by the snakes. This last hypothesis brings up the question as to whether the feeding responses of the snakes are entirely instinctive or whether they are in part conditioned behavior. There is no question about the above-mentioned acceptance of the three native species of *Rana* and bull frog tadpoles, nor of the refusal of the metamorphosed bull frogs by the admittedly limited number of *atratus, hydrophila,* and *couchi* upon which the test was made. Nevertheless, since I have not had the opportunity to repeat these tests with adequate numbers of individuals, I do not consider them in any sense conclusive. That snakes of the *T. elegans* species can learn to feed on metamorphosed bull frogs is established by the fact that *T. e. gigas* of the San Joaquin Valley and its intergrade in the Sacramento Valley feed extensively on small and half-grown bull frogs. I would expect that wherever one finds bull frogs and members of the aquatic group of garter snakes living

together to a marked extent, the snakes will be found to be feeding on the frogs.

In captivity odor plays an important role in the recognition of fish as food by all races. The aquatic races tested (*atratus, aquaticus, hydrophila, couchi,* and *hammondi*) initially showed no interest in the newborn rats and mice that were offered as food. Various techniques were employed to stimulate an interest in the rodents because they were more easily obtained than the preferred food of the snakes. Since it had been observed that the odor of fish produced very active feeding responses, an attempt was made to impart this odor to the rodents by smearing them with the oil from a piece of fish skin. This proved to be the only method of enticing these snakes to eat the rodents. Many individual snakes refused to eat the fish-coated rats; others quickly took the greased rats into their mouths and then released them immediately as though surprised by some unpleasant sensation. Subsequently, even the latter snakes refused to accept the camouflaged rats. Most of the aquatic snakes that did accept the coated rats regurgitated them, undigested and spoiling, two or three days later. All races of *T. elegans* apparently found the skins of the newborn rats very difficult to digest since these were frequently found intact or in very large pieces in the water dishes. This was equally true for *terrestris* which normally feeds on wild rodents. The terrestrial snakes were able to digest the newborn rats exclusive of the skin and throve well on this diet for several years. Most of the aquatic snakes that swallowed the fish-covered rats were unable to digest the flesh and viscera from within the skin. Only one specimen of *T. e. couchi* was successfully reared on this diet. It appeared in good health for nearly two years but gradually ate less and less and finally ceased feeding on the rats entirely. Cod liver oil was substituted for the fish skin but it did not produce as pronounced a response as oil from the fresh fish skin.

There has been quite a bit of discussion among herpetologists as to whether Pacific coast *Taricha* are eaten by any of the native reptiles or whether the thick, rough skin with its toxic secretions makes the genus distasteful. Fitch (1940:58) lists larval *Taricha* as occasional food of *T. e. hydrophila*. All of the races that I have raised in captivity fed freely on the larvae. To my knowledge, the only previously reported records of adult *Taricha* having been eaten by members of the *Thamnophis elegans* rassenkreis are some of my own for the race *atratus* from the San Francisco peninsula (Fox, 1951:492). This race fed on *Taricha* both in their natural habitat and in captivity. The other snakes of this species showed no interest in these particular newts, although they all fed freely on the native species of plethodontid salamanders. In this instance, also, it seemed that the snakes made the distinction between the newts and the plethodontid salamanders by means of the olfactory sense. Much speculation exists regarding the toxins of *Taricha* on its possible predators. There is ample evidence that toxins are present in the skin and other tissues of *Taricha*, but practically no specific information is available as to the effects of these toxins on animals which might be expected to serve as natural predators of the genus. I doubt very much that *T. e. atratus* is the only race of the species that is immune to *Taricha* toxins. However, since it would be remarkable if such were the case, the situation merits further investigation. Two records, one of my own and one of William Riemer and Richard G. Zweifel (personal communication), of *Thamnophis sirtalis* of the San Francisco peninsula feeding on *Taricha* indicate that other species of the genus can feed on the

newts without harm.

It is quite apparent that movements act as stimuli which arouse garter snakes to feeding behavior. In capturing a frog these snakes usually succeed in grasping the prey only after seeing it hop. In most instances, however, the search for food is initiated by odors from the frog. In the few previously mentioned cases wherein snakes were tricked into grasping a bull frog leg flapped about the cage, it would seem that movement alone was responsible for the response since the bull frog odor did not appear to stimulate the snakes.

Although the odor of tadpoles and fish excited the highly terrestrial race, *terrestris,* to feeding behavior, members of this subspecies were seldom successful in finding the prey if it was swimming quietly in the water dish. On the other hand, the aquatic races were very quick to enter the water dish and capture the moving tadpoles or fish. If the water was agitated by the prey the excitement of the snakes became intense. Here again the initial stimulus to feed could have been produced by odors. I learned, however, that the same excited, searching behavior could be produced by splashing the water in the dish when no odors of amphibians or fish were present.

The agitated searchings of one or two snakes in a cage usually elicited similar behavior from the other individuals in this cage. When hurriedly thrashing about after food, garter snakes are prone to grab at anything that moves. Consequently, it is not unusual to see them lunge at each other, or even for a snake to grasp a distant part of his own body. If not separated, large snakes will swallow their smaller relatives. This accidental grasping of the wrong prey may account for the occasional reports of cannibalism among garter snakes. I suspect that the feeding of these snakes upon any reptile is in response to the movements rather than to the odor of the prey. Lizards of the genus *Sceloporus* are not uncommonly found in the stomach of wild members of the terrestrial group of *T. elegans.* In captivity the terrestrial snakes occasionally ate lizards, although often the lizards remained unharmed in the cage with the snakes for several days. Clearly the odor from the lizards did not arouse the excited, searching behavior which was the normal response to other more customary food items.

The terrestrial races which I kept in large numbers for several years were routinely fed newborn laboratory rats. It was rare for even these snakes to eat the rats if the latter were merely placed in the cage with them. To encourage eating I adopted the method suggested by Lowe (1943) which entailed placing the rats in pint or half-pint cardboard ice cream cartons with a hole in the cover large enough for a snake to enter. This proved to be a most effective technique. To my knowledge, rats that squirmed out of the container to the floor of the cage were never eaten. Apparently, in this case odor alone was not strong enough or not specific enough to stimulate feeding. The feeble movements of the helpless rats, likewise, did not produce the feeding response. It may be that the sight of the rats grouped together in a nest-like structure or perhaps the mere sight of them through the hole in the box elicited the feeding reaction. The snakes were usually slow in finding the rats in the boxes; consequently I was never certain whether they were smelling them out or whether they discovered them by chance. After several months of feeding from the boxes many of the snakes would feed immediately after the box of rats was placed in the cage. It seemed that these individuals were conditioned to the boxes.

The capacity for learning in reptiles

needs much more thorough investigation. Many of the peculiar reactions to different types of food herein described might be more comprehensible if we had some knowledge as to the extent conditioning can influence the behavior of snakes.

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